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INTEGRATED FIELD INTENSITY OF ATMOSPHERICS IN RELATION TO MONSOON THUNDERCLOUDS

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(*Received September* 7, 1965)

Close association of atmospherics with thunderstorms is now well established. During the International Geophysical Year, observational programme directed solely towards the location and tracking of thunderstorms by recording atmospherics at a distance were undertaken in several countries (Pierce, 1956; Aipert and Borodina, 1956; Skieb, 1956; Maikowski, 1957; Kimpara, 1959, Samson and Linefield, 1962). In fact, even a single thunderstorm of nearby origin may give rise to quite large increase of atmospheric radio noise (Yabsley, 1960; Aiya, 1962). Large enhancements of atmospherics associated with severe premonsoon thunderstorms, popularly known as Nor'wester, were observed in Calcutta (Das Gupta and Sen, 1963; Sen, 1965a). Thundersqualls occurring in the monsoon season (June to October) also give rise to somewhat similar enhancements with, however, certain characteristic features. We were thus prompted to examine the daily records of the integrated field intensity of atmospherics particularly in relation to monsoon thunderstorms to study in details the nature of this association.

For the last four years we have been recording the integrated field intensity of atmospherics (abbreviated henceforth as i.f.i.a.) at Calcutta (lat. 22°34'N, long. 88°24'*E*) on 30 kc/s. The receiver employed for the present observations was based on the design adopted during the International Geophysical Year (Ellison, 1955) primarily for the purpose of solar flare patrol by the s.c.a. technique (sudden enhancement of atomospherics subsequent to solar flares) with some modifications. In Fig. 1 three typical records as obtained at Calcutta are shown. The upper one shows the i.f.i.a. recorded on a normal premonsoon day (26 March, 1962) while the lower two show i.f.i.a. when severe thundersqualls were experienced in and around Calcutta on two different dates. The record on a normal day shows the usual diurnal variations in the integrated field intensity of atmospherics (WMO, 1957) viz., sunrise drop (A), morning minimum (D), afternoon maximum (E), late minimum (F) and night maximum (G). The record (lower-left) on a disturbed day shows the sunrise effect (A) and morning minimum (D), after which unusually large enhancement of i.f.i.a. occurs, starting at 13-20 hrs. I.S.T. and obscuring E, F and G as observed on a normal day. Simi-

larly on another occasion as shown in the lower-right record the gradual increase in i.f.i.a. is also quite marked. However the predominant feature of these records seems to be the sudden decrease of i f.i.a. about the time of onset of heavy raining associated with the thundersquall as obtained from meteorological data. Figure in the left shows that i.f.i.a. starts decreasing at 18-00 hrs. I.S.T. while the local raining started at 17-20 hrs.I.S.T. and for the other one these occurred at 15-05 hrs. and 15-20 hrs. I.S.T. respectively.

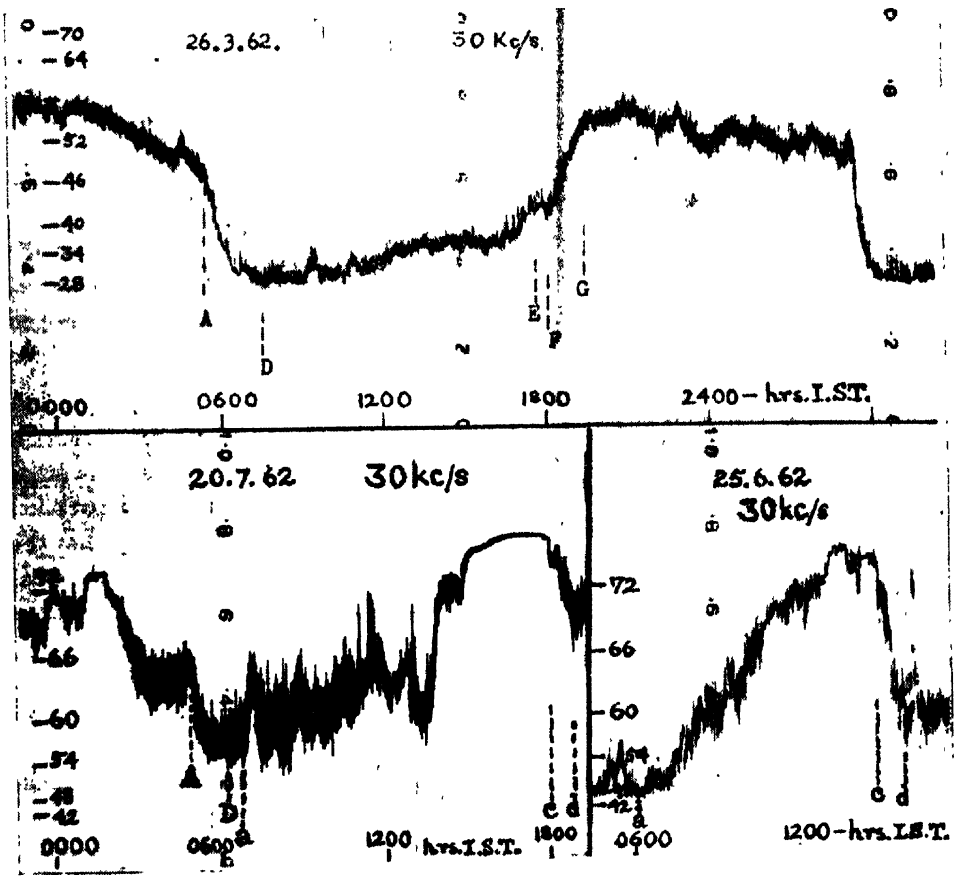

Fig. 1. Upper record shows the usual diurnal variations in the integrated field intensity of atmospherics on a normal premonsoon day (A : sunrise effect; D : morning minimum; E : afternoon maximum; F : late minimum; G : night maximum). The record on the lower left shows i.f.i.a. on a day when a severe thundersquall was experienced in Calcutta (a : i.f.i.a. starts rising gradually; c : decrease of i.f.i.a. starts; d : i.f.i.a. regians normal value). The lower right record shows i.f.i.a. on another day when a severe thundersquall was experienced in Calcutta. The ordinate shows the r.m.s. field strength for a 1 kc/s bandwidth in decibels above 1μV/m.

The results obtained in this analysis can be summarised as follows :

1. During the monsoon period under observation (June-September) there were altogether eleven thundersqualls reported by the Meteorological Department. In all these cases gradual increase in i.f.i.a. as shown in the above illustrations was detected.

2. The increase started in general 4 to 11 hours before the reported time of respective thundersqualls.

3. In all the cases sudden decrease of i.f.i.a. as depicted in the illustrations above occurred within ± 20 mins. of the reported time of onset of raining associated with the thundersquall. However, in majority of the cases the starting time of sudden decrease in i.f.i.a. seemed to cluster around the time of onset of the raining.

4. I.f.i.a. came down to the normal value within 12 to 180 minutes after the observed starting time of the decrease mentioned above.

The close association of the sudden decrease of i.f.i.a. with the onset of the heavy raining appears to be something peculiar to the monsoon thunderclouds. The sudden decrease of i.f.i.a. might be attributed to the falling out of charged rain from the cloud layer leading to a vanishing of the bipolar structure of the cloud. As a result probably all electrical discharges within the layer ceased.

It is now generally accepted that in a thundercloud, there are two processes of charge separation, one in the region above the freezing point level and the other below. Chalmers (1956) suggested that the two processes of charge separation are opposite to each other. In the present observations it appears likely that the process occurring below the freezing point lebel is significant, at least in the final stage of the cloud development. It might be that the Dinger and Gunn process of melting ice is at work at such times. According to them (Dinger and Gunn, 1946), ice particles contain entrapped air. On melting the entrapped air becomes charged negatively while the water drops receive positive charge. It thus appears that when the drops begin to fall as rain the bipolar structure of the cloud layer vanishes leading to the observed sudden decrease of i.f.i.a. That the i.f.i.a. decreases with raining also lends support to a view that the process of charge separation above the freezing point level characterized by its association of a marked increase of i.f.i.a. (Sen, 1965a) is significant in the final stage of the cloud development.

In support of the above discussions reference may be made to a recent evidence obtained from the measurement of the time lag between electric field change at ground and the onset of rain which also supports the view that the raining occurs from a height below the freezing level in cases of thunderstorms occurring in the monsoon season (Sivaramakrishnan, 1960). Comparative studies on i.f.i.a. associated with nor'westers and monsoon thundersqualls over an extended period

are in progress and will be reported in due course. It appears that simultaneous observations of i.f.i.a. supplemented by directional studies and of radar reflections from the thunderclouds might prove to be useful in locating the seat of the different types of enhancements as well as the decrease associated with the monsoon thunderclouds and might provide new insight into the process of formation of such thunderclouds.

We are grateful to Prof. J. N. Bhar, Head of the Department of Radio Physics and Electronics, Calcutta University, for his kind interest. Thanks are due to Dr. S. N. Sen, Regional Director, Alipore Meteorological Observatory, India Meteorological Department, Government of India, for kindly providing us with the relevant meteorological data. One of us (A.K.S.) is also thankful to the University Grants Commission, Government of India for financial assistance.

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